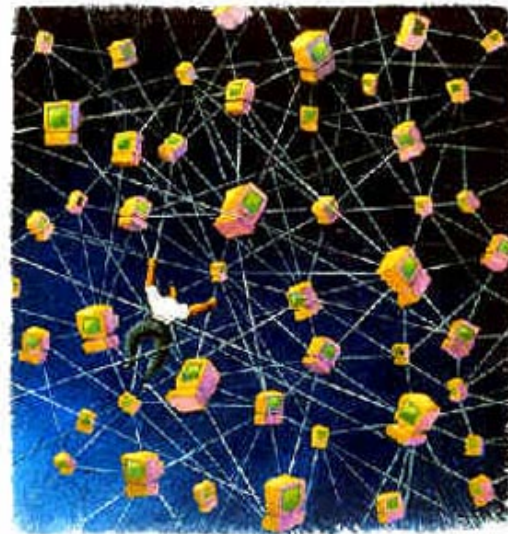


caBIG and Radiation Therapy Clinical Trials



Background



Quality Assurance Review Center (QARC):

A research program within the University of Massachusetts Medical School (UMMS) that provides radiotherapy (RT), quality assurance (QA), diagnostic imaging data management, and clinical research support.

***MAX:** A flexible and all-inclusive platform developed by QARC in order to address all of the specific needs of the clinical cooperative groups and industry partners*

The Advanced Technology Consortium (ATC):

A cooperative group supported by the National Cancer Institute to create a robust QA process to collect and review the image-based planning and verification data for patients enrolled on the 3D Oncology Group (3DOG) prostate dose-escalation protocol (RTOG 9406)

***CERR** is a MATLAB based, open source radiotherapy research environment which includes an extensive set of tools commonly found in radiotherapy planning systems, in addition to several review and analysis features. It has been developed by Joseph O. Deasy and his team at the Division of Bioinformatics & Outcomes Research, Washington University, St. Louis.*

Purpose



Goals

- **Develop and deploy informatics technology to minimize unintended inter-site and inter-clinician variability in the radiation therapy process**
- **Improve precision and reproducibility of data analysis via annotation and markup of treatment plans, diagnostic and therapeutic imagery**
- **Support integration with “omic” data, Pathology full slide data, clinical data**

Initial Project



- **A key tactic is to incorporate caBIG in the workflow of cooperative group clinical trials associated with QARC and ATC. Specifically, this endeavor will:**
 - Develop coordinated client infrastructure based on CERR and existing MAX clients to support remote review and markup/annotation of radiation treatment plans and diagnostic imaging
 - Extend this infrastructure with AIM (Annotations and Imaging Markup Developer - for annotation capture) and review clients built with XIP (eXtensible Imaging Platform)
 - Optimize client performance and secure PHI with server side rendering
 - Incorporate Evercore's Teramedica for storing RT objects in addition to using MAX for storing images and associated data
- **Start toward this goal by integrating caBIG and all of the current cooperative group quality assurance activities for imaging and radiation therapy into ATC and the VIEW consortium**

Radiation Treatment Review: Digital RT data viewed in CERR from the QARC database



MAX Database - sandy - Network - SecureMode - mde - [Patient Data]

File Edit Format Records Tools Adobe PDF

CERR: \\qarcdb.pei\CERR\Patient Data\ProcessedData\COG\ACN31c774919

File View Dose Metrics Scans Structures Help

Not For Clinical Use

CT window: --Manual--

Center Width

0 300

Dose

Tra: 29/107
z: -11.5299cm
S: 1
D: 1

Sag: 256/512
x: 48cm
S: 1
D: 1

Cor: 256/512
y: 0cm
S: 1
D: 1

Legend

- Cranialspinal axis C7-VLT Cochlea
- Cranialspinal axis P1 Hypothalamus/pituitary
- C spine volume
- Spinal cord
- Mandible
- Brain
- cribriform plate
- T-L gap
- skin
- CTVpf
- Boost PTV
- RSB
- LSB
- RT Cochlea
- Optic Chiasm
- 10 Gy

Command: help

Record: 12 of 276

Form View

Loaded ACN31c774919. Ready.

NUM

Remote Diagnostic Imaging Review: Dicommunicator: QARC Database Client



MAX Database - sandy - Network - SecureMode - mde - [frmPgDicommunicatorViewerTwoStudies : Form]

File Edit Format Records Tools Adobe PDF

Image Activity Attributes

Active Tool

Scroll Win/Lev
 Select Zoom
 Flip/Rotate Measure...

Coop Group: COG
 Protocol: ACN31
 Case Number: 774919
 Study Date: 9/24/2007
 Preset: Unspecified
 Format: 1:1

QARC Number
 ASCACN31AJ*H
 Slice Thickness: 5
 Study: MRI BRAIN WITH AND WITHOUT CONTRAS
Series Navigation
 Series: 1/10 T1 SAG
Image Navigation
 Image 10 of 19

Attributes Left Side Viewer

Image Activity Attributes

Active Tool

Scroll Win/Lev
 Select Zoom
 Flip/Rotate Measure...

Coop Group: COG
 Protocol: ACN31
 Case Number: 774919
 Study Date: 9/29/2007
 Preset: Unspecified
 Format: 1:1

QARC Number
 ASCACN31AJ*H
 Slice Thickness: 5
 Study Navigation: MR Brain w/ & w/o Contrast
Series Navigation
 Series: 1/12 T1 Sag
Image Navigation
 Image 10 of 19

Attributes Right Side Viewer

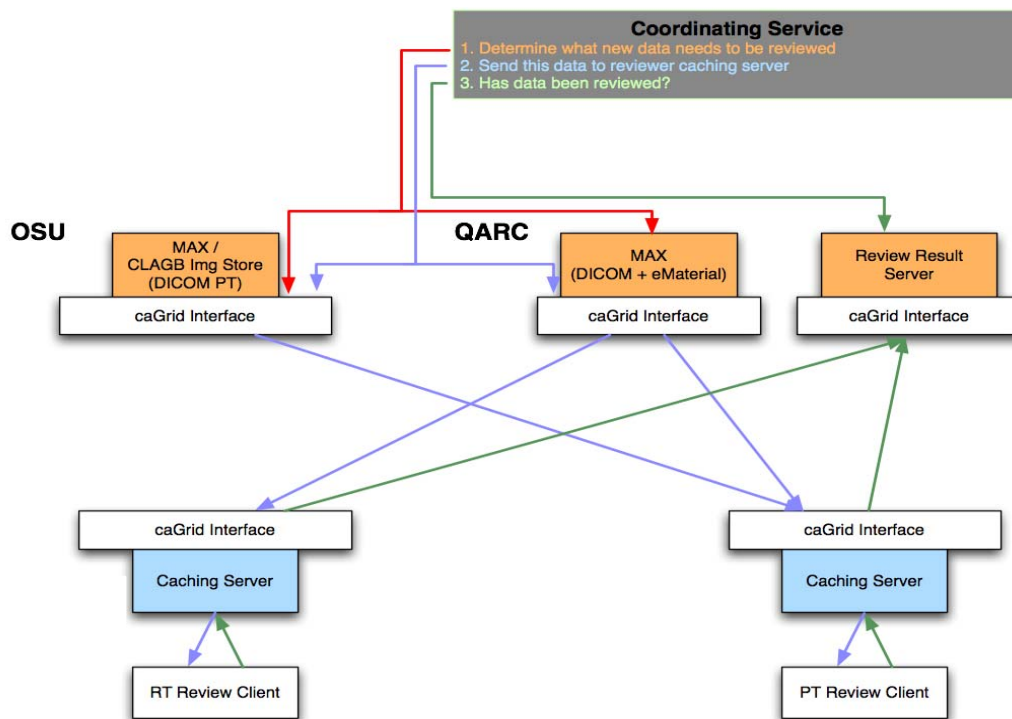
Form View

FLTR NUM

Initial Planned Backend Work



- A Grid enabled MAX cache will be developed and distributed to study investigators in CALGB protocol 80302. This will permit the image and radiation therapy treatment objects to be distributed and made accessible for protocol review by study investigators.
- Caching servers will be developed to support these clients, which will push the data to the reviewer. This gives the reviewer a local instance of MAX, but one that contains only the data to be reviewed



Initial Planned Work

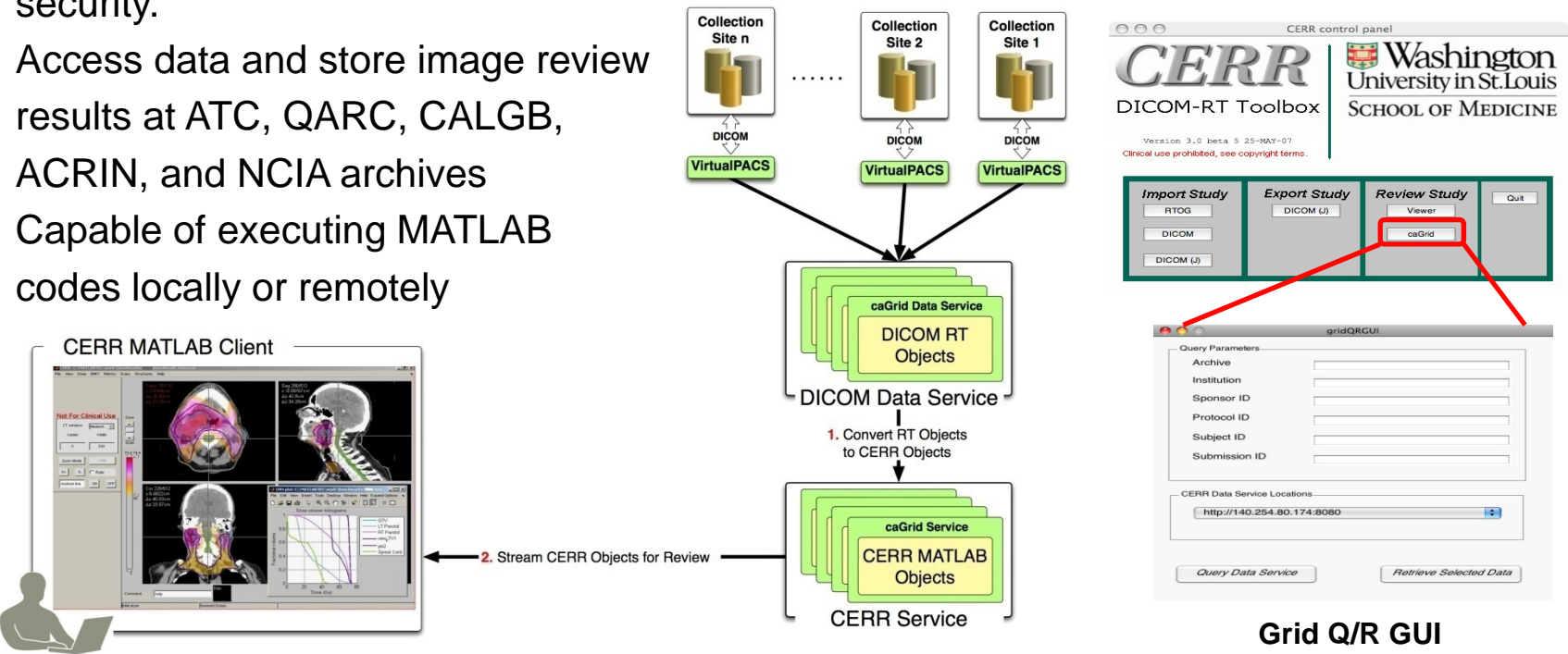


- **Develop tool that leverages CERR and MAX to support coordinated diagnostic and therapeutic review**
- **Leverage XIP infrastructure where appropriate**
- **Develop caGrid standards-based streaming middleware extensions (skunkwork project)**
- **Leverage streaming middleware data transport to implement server side rendering (skunkwork project)**
- **Leverage streaming middleware to support remote review**

Recent Work: caGrid Enabled CERR



- caGrid enabled data collection in cooperative groups
 - caGrid 1.2 data services for CERR & DICOM RT Objects. The CERR data service stores the metadata in a XML database, and leverages caGrid Transfer Service for bulk data transport from/to client
- The CERR client capable of interacting with caGrid services. The client is modified to support grid based query/retrieve/submit functionality and caGrid security.
- Access data and store image review results at ATC, QARC, CALGB, ACRIN, and NCIA archives
- Capable of executing MATLAB codes locally or remotely



Grid Q/R GUI

Core Components



- **Computational Environment for Radiotherapy Research (CERR)**
- **caGrid data services to store CERR Objects and DICOM RT Objects**
- **caGrid and In Vivo Imaging Middleware for query; high performance data transfer between clients and data repositories; authentication and authorization**

Background: In Vivo Imaging Middleware



- **Purpose: create the core infrastructure for Grid enabling imaging applications**
- **Services, tools, and APIs**
- **DICOM–Grid interoperability**
- **High-performance data transfer**
- **Development/deployment tools for imaging-based grid services**
- **Security**
- **Layered on the caGrid toolkit**

IVI Middleware - Capabilities



- **DICOM data service**
 - Provides a two way interface between caGrid and DICOM entities
 - Supports DICOM C_FIND, C_GET, C_MOVE, and C_STORE commands
- **Image data service (similar to DICOM data service, storing generic images on a file system)**
- **VirtualPACS**
 - Provide DICOM messaging interface to caGrid DICOM data services
 - Federate multiple grid services
- **Security**
 - User-level authorization
 - Data-level authorization
 - Transport-level authorization
- **Federated Query Processor**
 - Mechanisms to perform basic distributed aggregations and joins of queries over multiple data services

Summary



- **Initial small scale caBIG in vivo imaging workspace project funded – joint between Emory, ATC, ITC, QARC**
- **Collaborative effort with Joe Deasy to develop optimized production level caGrid enabled CERR**
- **Correlative Radiology/Pathology/”omic” studies**